LITEMAX LF1745

Sunlight Readable 17" LCD Display

(1st Edition 4/9/2004)

All information is subject to change without notice.

LITEMAX Electronics Inc.

4F, No.131-3, Lane235, Bau-chiau Rd.,

Shin-dian City, Taipei County, Taiwan R.O.C.

Tel : 886-2-8919-1858

Fax: 886-2-8919-1300

Homepage: http://www.litemax.com.tw

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INTRODUCTION AND OVERVIEW

This is a product specification that specifies form, fit, and function of the 17" TFT LCD monitor and its options. The LF1745 products are a family of high bright LCD monitors intended for use in a variety of industrial and commercial applications. Some of these applications include automatic teller machines (ATMs), fuel dispensing systems, ticketing and information kiosks, and intelligent vending machines. The LCD panel for LF1745 has a particularly fast response time of 16ms and consequently very well suited for video applications. The LF1745 is a 17" active matrix TFT LCD with a native resolution of 1280X1024. It has a typical luminance of 1000 nits with a +12VDC input. The video interface is through a standard 15 pin analog input with an integrated On-Screen Display (OSD).

OUTLINE

STRUCTURE AND PRINCIPLE

LF1745 module is composed of the driver LSIs for driving the TFT (Thin Film Transistor) array with an amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure and a backlight. The a-Si TFT LCD panel structure is injected liquid crystal material into the narrow gap between a TFT array glass substrate and a color filter glass substrate.
RGB (Red, Green, and Blue) data signals from a source system are modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn address the individual TFT cells.
Working as an electro-optical switch, each TFT cell regulates transmitted light from the backlight assembly when worked by the data source. Color images are created by regulating the amount of transmitted light through the array of red, green and blue dots.

APPLICATIONS

- Kiosk, Public, Health Application, LCD TV, POI, Ticketing, Advertising, Gaming, Industrial Computing, Signage...

FEATURES

- wide viewing angle
- Fast response time
- High luminance
- High contrast
- Wide color gamut
- Luminance control
- Small foot prints

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GENERAL SPECIFICATIONS

Display area	337.92 (H) x 270.336 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262k
Number of pixels	1280 (H) x 1024 (V) pixel
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe
Pixel pitch	0.264 (H) x 0.264 (V) mm
Module size	358.5(H) x 296.5 (V) x 29(D) mm
Weight	1670 g (typ.)
Contrast ratio	500:1 (typ.)
Viewing angle	At the contrast ratio 10:1 • Horizontal: Left side 80° (typ.), Right side 80° (typ.) • Vertical: Up side 75° (typ.), Down side 75° (typ.)
Designed viewing direction	• Optimum grayscale (γ =2.2): perpendicular
Polarizer pencil-hardness	3H (min.) [by JIS K5400]
Color gamut	At LCD panel center 60% (typ.) [against NTSC color space] Ton (black 10%→white 90%)
Response time	16 ms (typ.)
Luminance	1000 cd/m^2 (typ.)
Backlight	• Backlight unit: AU 1745 • Inverter: LI3601
Power consumption	At maximum luminance and checkered flag pattern 55 W (typ.)

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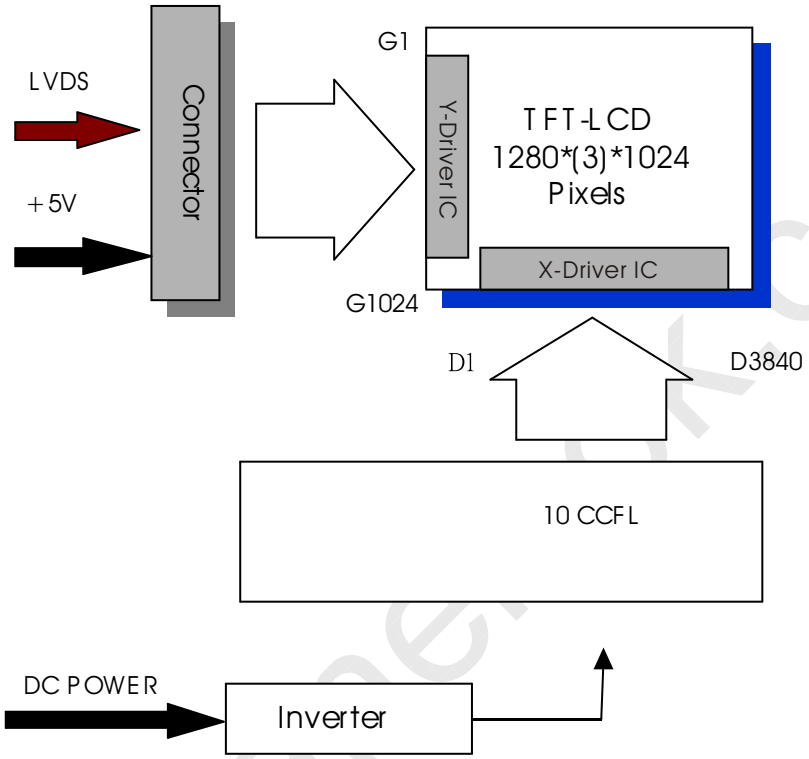
Functional Block Diagram

The following diagram shows the functional block of the 17.0 inches Color TFT-LCD Module:



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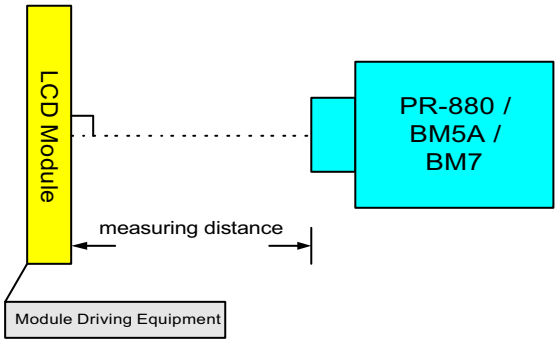
Optical Characteristics

The optical characteristics are measured under stable conditions at 25℃ (Room Temperature) :

Item	Unit	Conditions	Min.	Typ.	Max.
Viewing Angle	[degree]	Horizontal (Right) CR = 10 (Left)	60 60	80 80	-
		Vertical (Up) CR = 10 (Down)	60 60	75 75	-
		Horizontal (Right) CR = 5 (Left)	70 70	85 85	- -
		Vertical (Up) CR = 5 (Down)	70 70	80 80	- -
Contrast ratio		Normal Direction	-	500	-
Response Time (Note 1)	[msec]	Raising Time	-	4	5
		Falling Time	-	12	20
		Raising + Falling	-	16	25
Color / Chromaticity Coordinates (CIE)		Red x	0.61	0.64	0.67
		Red y	0.31	0.34	0.37
		Green x	0.26	0.29	0.32
		Green y	0.58	0.61	0.64
		Blue x	0.11	0.14	0.17
		Blue y	0.04	0.07	0.10
Color Coordinates (CIE) White		White x	0.28	0.31	0.34
		White y	0.30	0.33	0.36
White Luminance @ CCFL 7.0mA (center)	[cd/m^2]		-	1000	-
Luminance Uniformity (Note 2)	[%]		75	80	-
TCO99 1.5.2B luminance uniformity (Note 3)					1.7
Crosstalk (in 75Hz) (Note 4)	[%]				1.5

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (PR 880, BM-5A)
Aperture 1° with 100cm VD or 2° with 50cm viewing distance
Test Point Center (ISO point 22)
Environment < 1 lux



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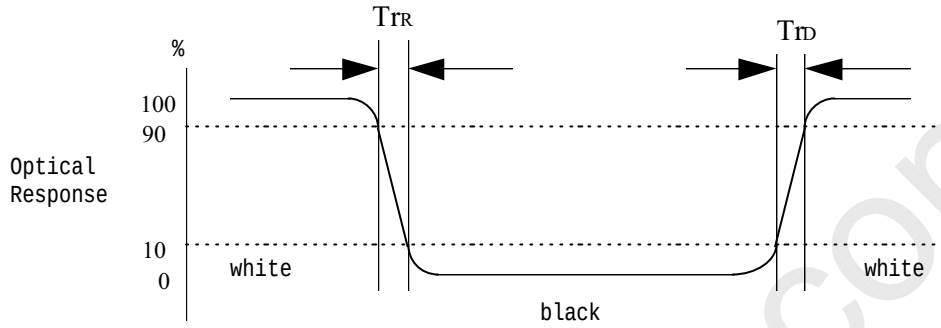
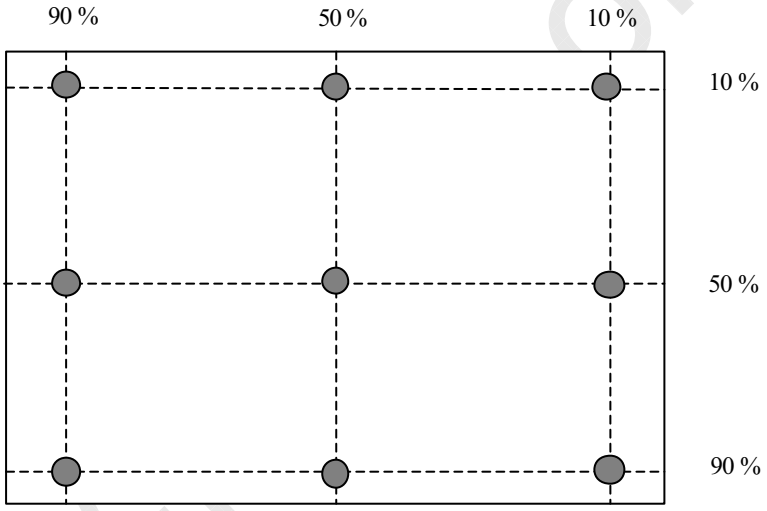
Note 1: Definition of Response time:

The output signals of photodetector are measured when the input signals are changed from " Black" to " White" (falling time), and from "White" to " Black" (rising time), respectively. The response time is interval between the 10% and 90% of amplitudes.



Note 2: Brightness uniformity of these 9 points is defined as below:



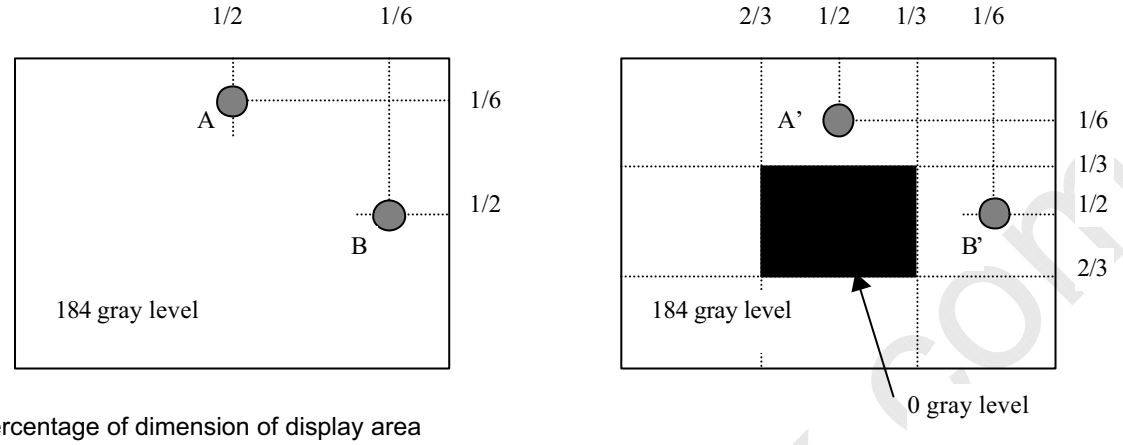
$$\text{Uniformity} = \frac{\text{Minimum Luminance in 9 Points (1-9)}}{\text{Maximum Luminance in 9 Points (1-9)}}$$

Note 3: TCO ' 99 Certification Requirements and test methods for environmental labeling of Display Report No. 2 defines Luminance uniformity as below:

((Lmax,+30deg. / Lmin,+30deg.) + (Lmax,-30deg. / Lmin,-30deg.)) / 2

This panel is compatible with TCO99 approbation in luminance uniformity ≤1.7, luminance contrast >0.5

Note 4:



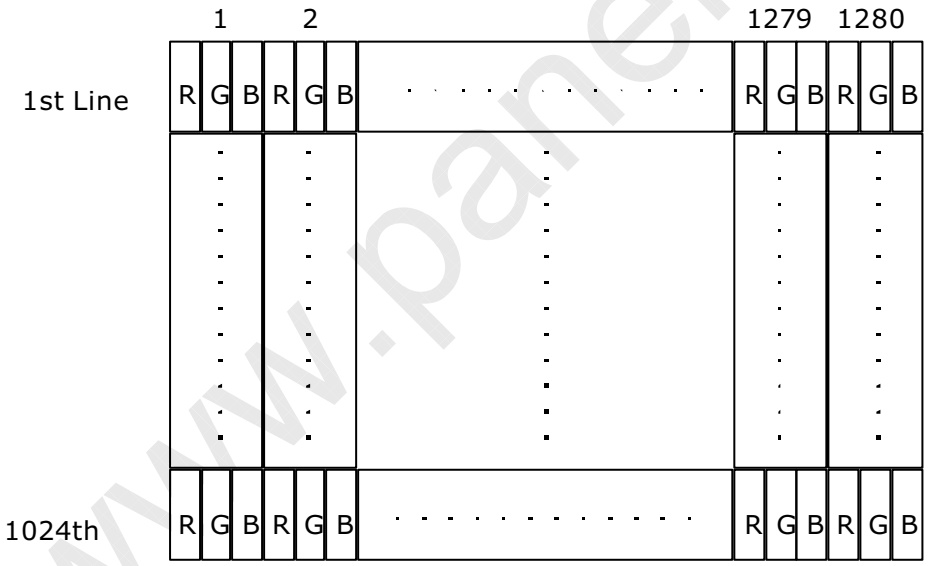
Unit: percentage of dimension of display area

I L_A-$L_{A'}$ I / L_A x 100%= 1.5% max., L_A and L_B are brightness at location A and B

I L_B-$L_{B'}$ I / L_B x 100%= 1.5% max., $L_{A'}$ and $L_{B'}$ are brightness at location A' and B'

Pixel format image

Following figure shows the relationship of the input signals and LCD pixel format.



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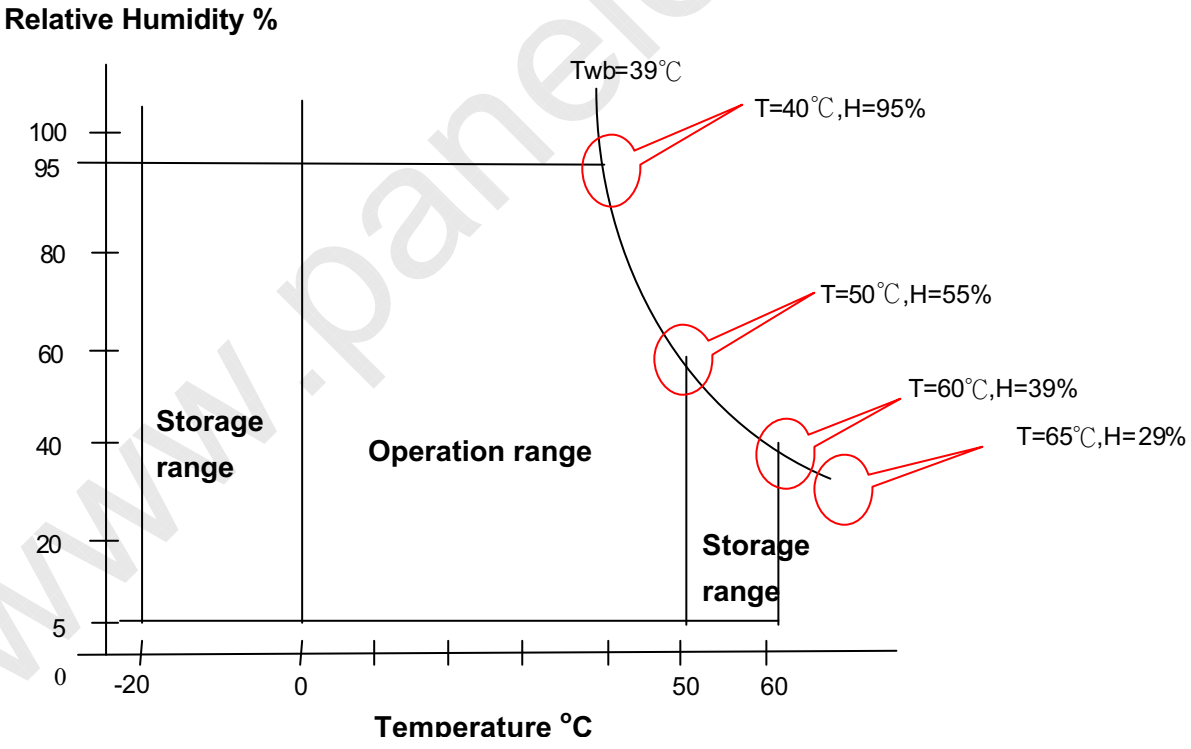
Electrical characteristics

Absolute Maximum Ratings

Absolute maximum ratings of the module is as following:

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	VIN	-0.3	+5.5	[Volt]	
Select LVDS data order	SELLVDS	NC	NC	[Volt]	
CCFL Inrush current	ICFLL	-	38	[mA]	
CCFL Current	ICFL	-	7.6	[mA] rms	
Operating Temperature	TOP	0	+50	[°C]	Note 1
Operating Humidity	HOP	8	95	[%RH]	Note 1
Storage Temperature	TST	-20	+60	[°C]	Note 1
Storage Humidity	HST	8	95	[%RH]	Note 1

Note 1 : Maximum Wet-Bulb should be 39℃ and No condensation.



Connectors

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

Connector Name / Designation	Interface Connector / Interface card
Manufacturer	JAE or compatible
Type Part Number	FI-X30S-HF
Mating Housing Part Number	FI-X30S-H

Connector Name / Designation	Lamp Connector / Backlight lamp
Manufacturer	JST
Type Part Number	BHR-04VS-1
Mating Type Part Number	SM04(4.0)B-BHS-1-TB

Signal Pin

Pin#	Signal Name	Pin#	Signal Name
1	RxO0-	2	RxO0+
3	RxO1-	4	RxO1+
5	RxO2-	6	RxO2+
7	GND	8	RxOC-
9	RxOC+	10	RxO3-
11	RxO3+	12	RxE0-
13	RxE0+	14	GND
15	RxE1-	16	RxE1+
17	GND	18	RxE2-
19	RxE2+	20	RxEC-
21	RxEC+	22	RxE3-
23	RxE3+	24	GND
25	NC	26	NC
27	NC	28	Power
29	Power	30	Power

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Signal Description

The module using a pair of LVDS receiver SN75LVDS82 (Texas Instruments) or compatible. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling) or compatible. The first LVDS port(RxOxxx) transmits odd pixels while the second LVDS port(RxExxx) transmits even pixels.

PIN #	SIGNAL NAME	DESCRIPTION
1	RxO0-	Negative LVDS differential data input (Odd data)
2	RxO0+	Positive LVDS differential data input (Odd data)
3	RxO1-	Negative LVDS differential data input (Odd data)
4	RxO1+	Positive LVDS differential data input (Odd data)
5	RxO2-	Negative LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG)
6	RxO2+	Positive LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG)
7	GND	Power Ground
8	RxOC-	Negative LVDS differential clock input (Odd clock)
9	RxOC+	Positive LVDS differential clock input (Odd clock)
10	RxO3-	Negative LVDS differential data input (Odd data)
11	RxO3+	Positive LVDS differential data input (Odd data)
12	RxE0-	Negative LVDS differential data input (Even clock)
13	RxE0+	Positive LVDS differential data input (Even data)
14	GND	Power Ground
15	RxE1-	Positive LVDS differential data input (Even data)
16	RxE1+	Negative LVDS differential data input (Even data)
17	GND	Power Ground
18	RxE2-	Negative LVDS differential data input (Even data)
19	RxE2+	Positive LVDS differential data input (Even data)
20	RxEC-	Negative LVDS differential clock input (Even clock)
21	RxEC+	Positive LVDS differential clock input (Even clock)
22	RxE3-	Negative LVDS differential data input (Even data)
23	RxE3+	Positive LVDS differential data input (Even data)
24	GND	Power Ground
25	NC	-
26	NC	-
27	NC	-
28	POWER	Power
29	POWER	Power
30	POWER	Power

Note: Input signals of odd and even clock shall be the same timing.

LVDS DATA Name	Description
DSP	Display Timing: When the signal is high, the pixel data shall be valid to be displayed
V-S	Vertical Sync: Both Positive and Negative polarity are acceptable
H-S	Horizontal Sync: Both Positive and Negative polarity are acceptable

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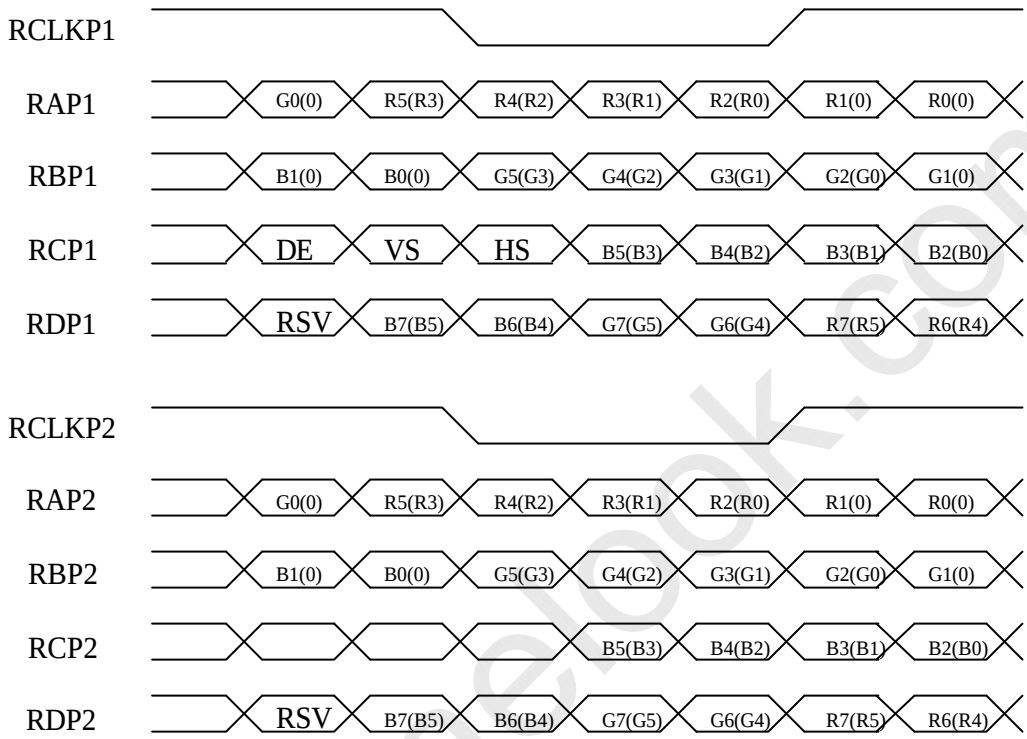
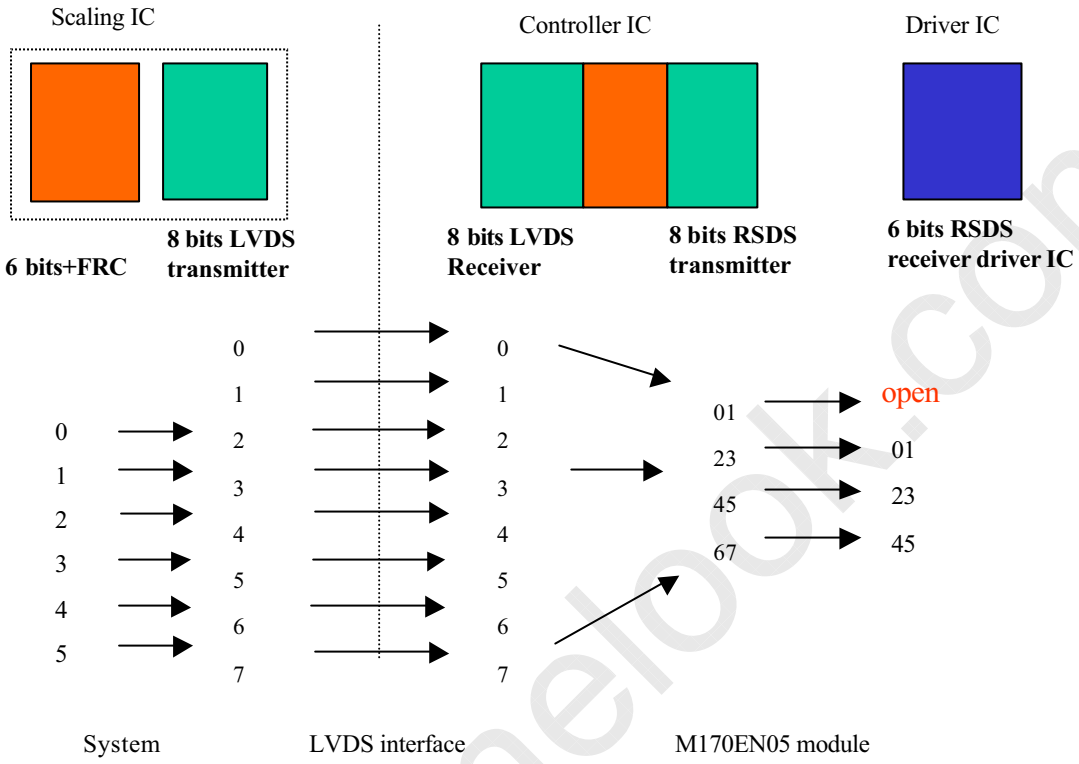
Interface connection

TI LVDS X' mitter SN75LVDS83	Module LVDS signal (interface connector pin7)
Signal Name	**Low(open)**
D0	Red0
D1	Red1
D2	Red2
D3	Red3
D4	Red4
D5	Red7
D6	Red5
D7	Green0
D8	Green1
D9	Green2
D10	Green6
D11	Green7
D12	Green3
D13	Green4
D14	Green5
D15	Blue0
D16	Blue6
D17	Blue7
D18	Blue1
D19	Blue2
D20	Blue3
D21	Blue4
D22	Blue5
D23	NA
D24	H Sync
D25	V Sync
D26	Display Timing
D27	Red6

8bits input: M170EN05 only catch bit 2 to bit 7 for 6 bit display
6bits input data format marked with ( ).



Note: R/G/B data 7:MSB, R/G/B data 0:LSB
O = "First Pixel Data"
E = "Second Pixel Data"



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Signal Electrical Characteristics

Input signals shall be low or Hi-Z state when Vin is off
It is recommended to refer the specifications of SN75LVDS82DGG (Texas Instruments) in detail.

Each signal characteristics are as follows;

Parameter	Condition	Min	Max	Unit
Vth	Differential InputHigh Voltage(Vcm=+1.2V)		100	[mV]
Vtl	Differential Input Low Voltage(Vcm=+1.2V)	-100		[mV]

Interface Timings

Basically, interface timings described here is not actual input timing of LCD module but output timing of SN75LVDS82DGG (Texas Instruments) or equivalent.

Timing Characteristics

Signal	Item	Symbol	MIN	TYP	MAX	Unit
DTCLK	Freq.	Fdck	50	67.5	70	MHz
DTCLK	Cycle	Tck	14.2	14.8	20	ns
+V-Sync	Frame Rate	1/Tv	56.25	75	77	Hz
+V-Sync	Cycle	Tv	13	13.33	17.78	ms
+V-Sync	Cycle	Tv	1035	1066	2047	lines
+V-Sync	Active level	Tva	3	3		lines
+V-Sync	V-back porch	Tvb	7	38	63	lines
+V-Sync	V-front porch	Tvf	1	1		lines
+DSPTMG	V-Line	m	-	1024	-	lines
+H-Sync	Scan rate	1/Th	-	80.06	-	KHz
+H-Sync	Cycle	Th	800	844	1023	Tck
+H-Sync	Active level	Tha (*1)	4	56		Tck
+H-Sync	Back porch	Thb (*1)	4	124		Tck
+H-Sync	Front porch	Thf	4	24		Tck
+DSPTMG	Display Pixels	n	-	640	-	Tck

Note: Typical value refer to VESA STANDARD (*1) Tha+Thb should be less than 1024 Tck.

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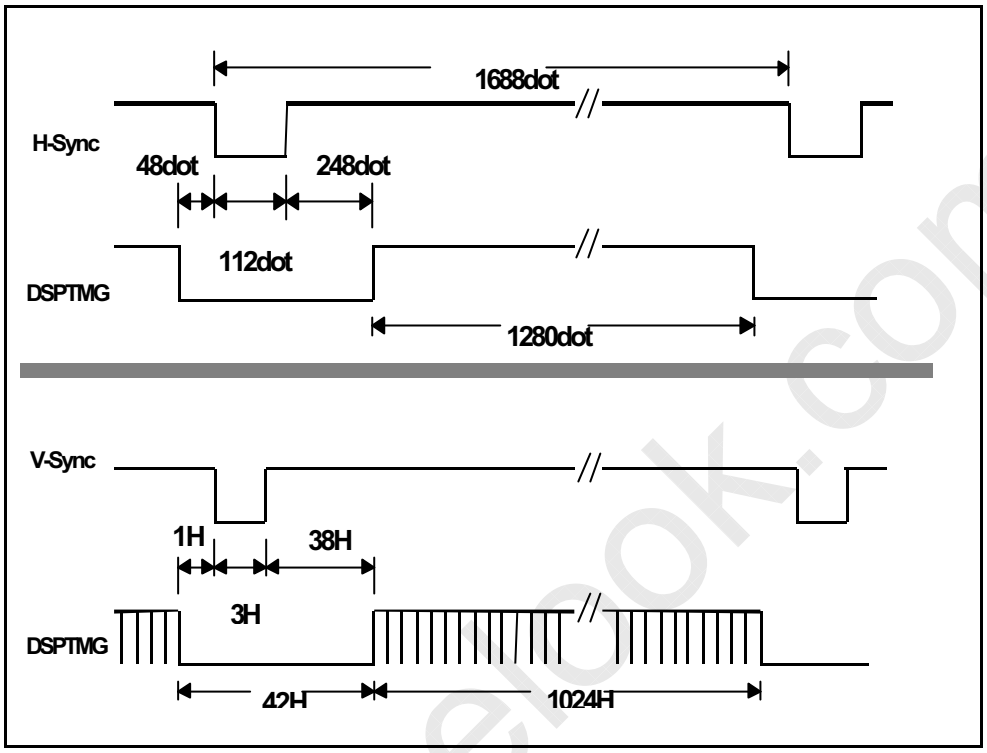
Timing Definition



Power Consumption

Input power specifications are as follows;

Symbol	Parameter	Min	Typ	Max	Units	Condition
VDD	Logic/LCD Drive Voltage	4.5	5	5.5	[Volt]	
IDD	VDD current		950	1200	[mA]	
PDD	VDD Power		4.75	6.6	[Watt]	Vin=5V, All Black Pattern
VDDrp	Allowable Logic/LCD Drive Ripple Voltage			100	[mV] p-p	
VDDns	Allowable Logic/LCD Drive Ripple Noise			100	[mV] p-p	

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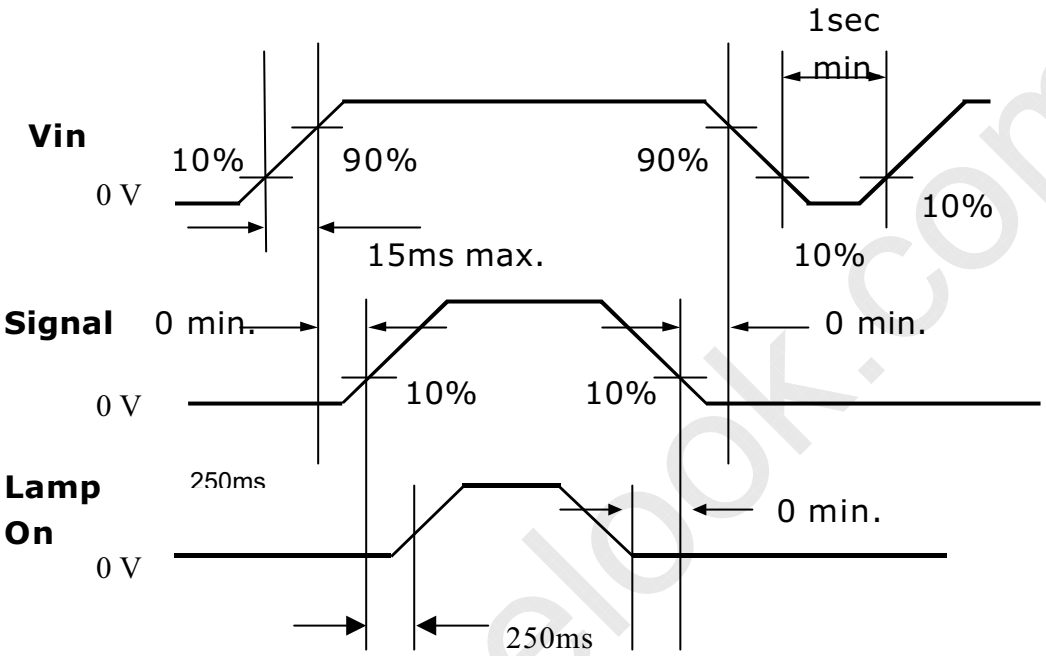
Power ON/OFF Sequence

Vin power and lamp on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when Vin is off.



Backlight Characteristics

Signal for Lamp connector

Pin #	Signal Name
1	Lamp High Voltage
2	Lamp High Voltage
3	No Connection
4	Ground

Reliability and Lifetime

Monitor Reliability
Demostrated MTTF testing in progress

Backlight Reliability and Lifetime
CCF lamps; 40,000 hour rated lifetime @ 25°C
CCF lamp life is defined as time to 50% of initial brightness
Backlight end-of-life for this 1745 product is defined as 1000 nits center luminance at 25°C

Typical values indicated for luminance and uniformity are indicative of typical steady state values measured at initial use at 25°C after warm-up to steady state. Actual luminance and uniformity values are directly dependent on the environmental usage profile. Repeated cold temperature start-up can cause accelerated aging of the backlight lamps resulting in reduced luminance and uniformity.

Extended High Temperatures and Solar Loading
Extended operation at the upper temperature extreme or in conjunction with extended direct solar loading can cause permanent mura or localized pixel non-uniformity effects. Other side effects could include latent image and flicker. These effects are not covered under Litemax warranty. Please consult Litemax for further guidance on system design to effectively manage environments requiring extended high temperatures or direct sun-loading. Cooling kit and CEG vandal glass options can effectively address these issues.

Reliability Test

Test Item		Test ondition	Judgement
High temperature/humidity operation		1. 60±2°C, RH=60%, 240 hours, 2. Display data is white.	Note 1
Heat cycle (operation)		1. 0°C±3°C..1 hour 2. 55°C±3°C..1 hour 3. 50 cycles, 4 hours/cycle 4. Display data is white.	Note 1
Thermal shock (non-operation)		1. -20°C±3°C..1 hour 2. 60°C±3°C..1 hour 3. 100 cycles, 4 hours/cycle 4. Temperature transition time is within 5 min.	Note 1
Vibration (non-operation)		5-100Hz, 11.76m/s2, 1 minute/cycle, XYZ direction 10 times each direction	Note 1
ESD (non-operation)		150pF, 150Ω, ±10kV 9 places on a panel (Note 3) 10 times each place at one-second intervals	Note 1
Dust (non-operation)		Sample dust: No.15 Hourly 15 seconds stir, 8times repeat	Note 1
Low pressure	operation	53.3 kPa 0°C±3°C. 24 hours 55°C±3°C. 24 hours	Note 1
	non-operation	15 kPa -20°C±3°C. 24 hours -60°C±3°C. 24 hours	Note 1

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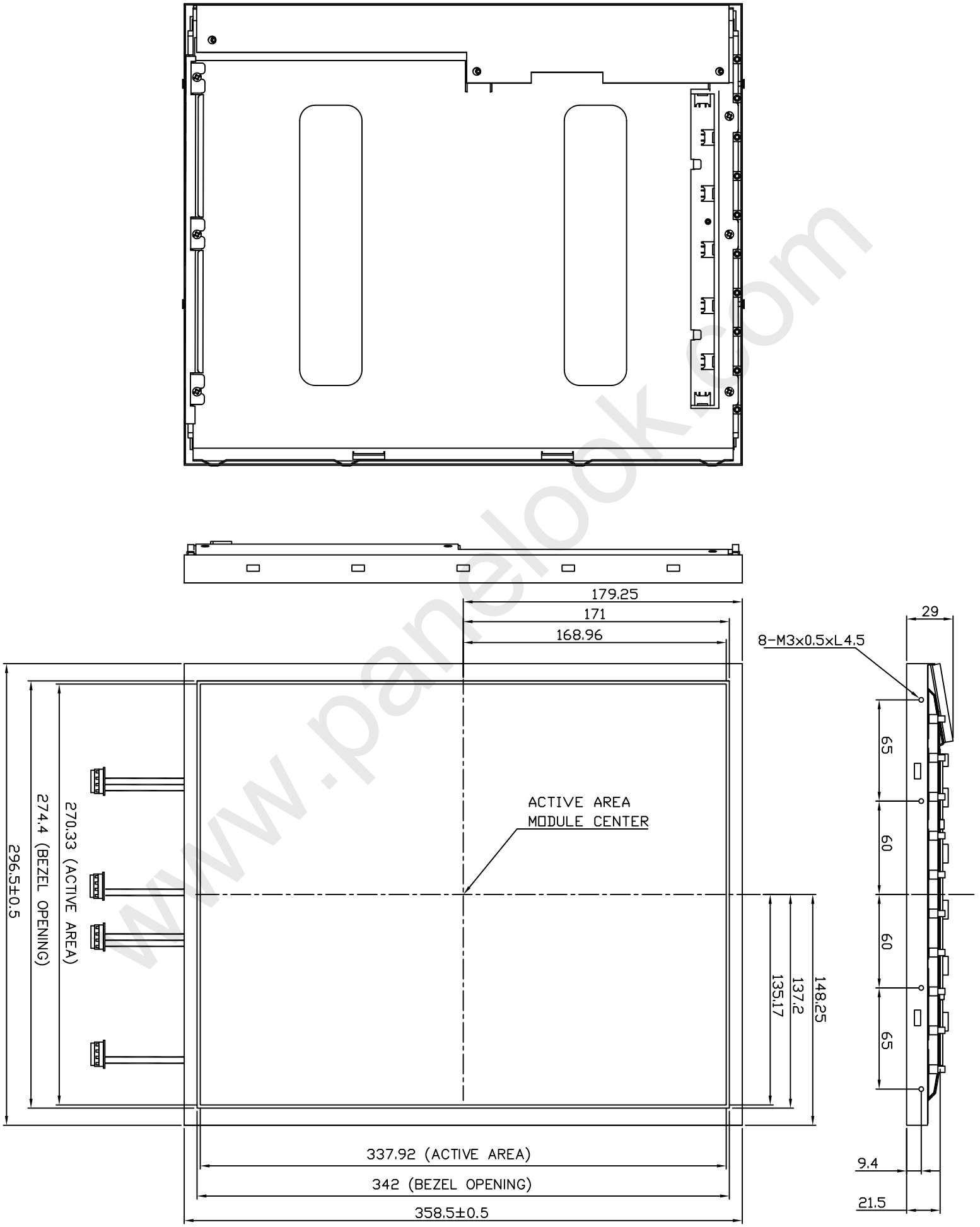
Mechanical Characteristics



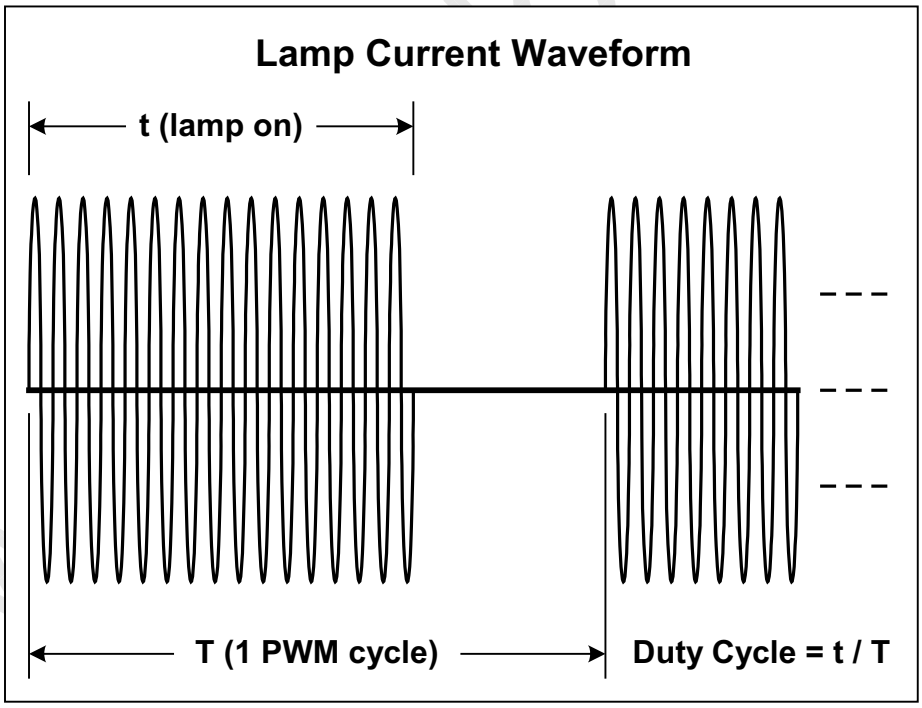
LITEMAX LI3601 inverter

Introduction

LI3601 is a CCFL inverter to operate LITEMAX high brightness (HB) backlights. The inverter has an on-board pulse width modulation (PWM) dimming circuit for extremely wide range luminance adjustment. Over the entire dimming range, there is no noticeable lamp flickering and the uniformity of the backlight is well maintained. When using LI3601 with LITEMAX LCD modules, it is not necessary to synchronize the PWM circuit to vertical sync signal of the LCD.

Dimming Control

The LI3601 accepts a 0V to 5V analog voltage for dimming control. It has a pulse width modulation (PWM) dimming circuit for luminance adjustment. As the dimming voltage (Vd) decreases from +5V, the lamp current waveform is pulse width modulated at a repetition rate high enough to prevent LCD flicker. Within each PWM cycle, the lamps in the backlight are turned fully 'ON' for a fraction of the cycle time. The human eyes, being very slow with respect to the PWM rate, respond to the average light produced over the PWM cycle. As a result, the luminance of the backlight and/or the LCD screen is approximately to the duty cycle of the PWM waveform.



The lamp current waveform with the PWM circuit set at less than 100%

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In general, inverters with PWM dimming have a very wide luminance adjustment range. For most practical cases, the LI3601 inverter can achieve a dimming ratio up to 200:1. Hence, the luminance of the backlight or LCD screen can be adjusted from 100% to 0.5%.

The 0V to 5V dimming voltage can be generated simply by a potentiometer, by a digitally controlled UP/DOWN counter or a digital potentiometer. The inverter provides a regulated +5V supply to power the dimming circuit. However, the maximum current drain from this source should be kept less than 5 mA.

At a Vd input about 0.34V and less, the duty cycle of the PWM waveform is 0% and thus, the lamps are 'OFF'. In order to fully utilize the available dimming voltage, Vd should be biased to about 0.34V and then ramping up to 5.0V.

Electrical Characteristics

The LI3601 inverter operates at 12V DC and can drive up to 12 lamps for a maximum output power about 63 Watts. In addition, the inverter has a regulated +5V output serving as a voltage source for the dimming control circuit.

Electrical Characteristics

Parameters	Min	Typ	Max	Units	Conditions
Input Voltage (Vin)	11.5	12	12.5	Vdc	
Input current (I)		5.25		Adc	Vin=12, Vd=5 V
Lamp Starting Voltage (Vst)		1300		Vrms	Vin=12, Vd=5 V
Frequency (f)	55	58	60	Khz	
ON/OFF Control -OFF			0.2	Vdc	
-ON		Floating*			
Dimming Voltage(Vd)					
@ 100% Duty Cycle		4.9	5	Vdc	Max brightness
@ 0% Duty Cycle		0.34	0.36	Vdc	Zero brightness
5V Output (+5VOUT)	4.85	5	5.25	Vdc	11.5<Vin<12.5V
5V Output Source Current			5	mA	

***Please refer to Application Note AN001 for details of On/Off control and dimming control with an external PWM signal.**

Absolute Maximum Rating

Parameters	Min	Max	Units
Inverter Input Voltage (Vin)	11	13	Vdc
Operating Temperature Range	0	50	C
Storage Temperature Range	-20	80	C

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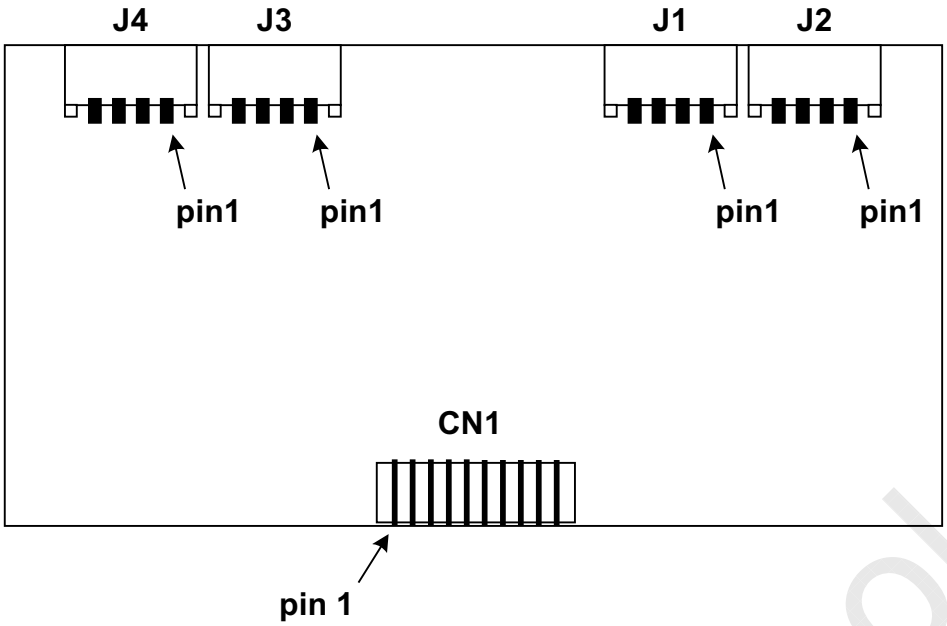
Interface Connector



Input Connector (CN1)

Pin#	Function
1	5V Output
2	12V Input
3	12V Input
4	Dimming Control
5	Ground
6	Ground
7	ON/OFF Control
8	NC
9	PWMCTRL
10	NC

Output Connector (J2, J3)

PIN#	Function
1	Lamp Connection
2	Lamp Connection
3	Lamp Connection
4	NC

Output Connector (J1, J4)

PIN#	Function
1	Lamp Connection
2	Lamp Connection
3	NC
4	Lamp Common

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Mechanical